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EASTERN HEMLOCK

The wood of eastern hemlock is moderately light in weight, moderately hard, coarse grained, uneven in texture, and inclined to splinter when machined. Although moderately low in bending strength and shock resistance, eastern hemlock can be used in construction for light framing, sheathing, subflooring, and roofing. It is much used in the manufacture of boxes, crates, pallets, and as paper pulp for newsprint and other low-quality papers.

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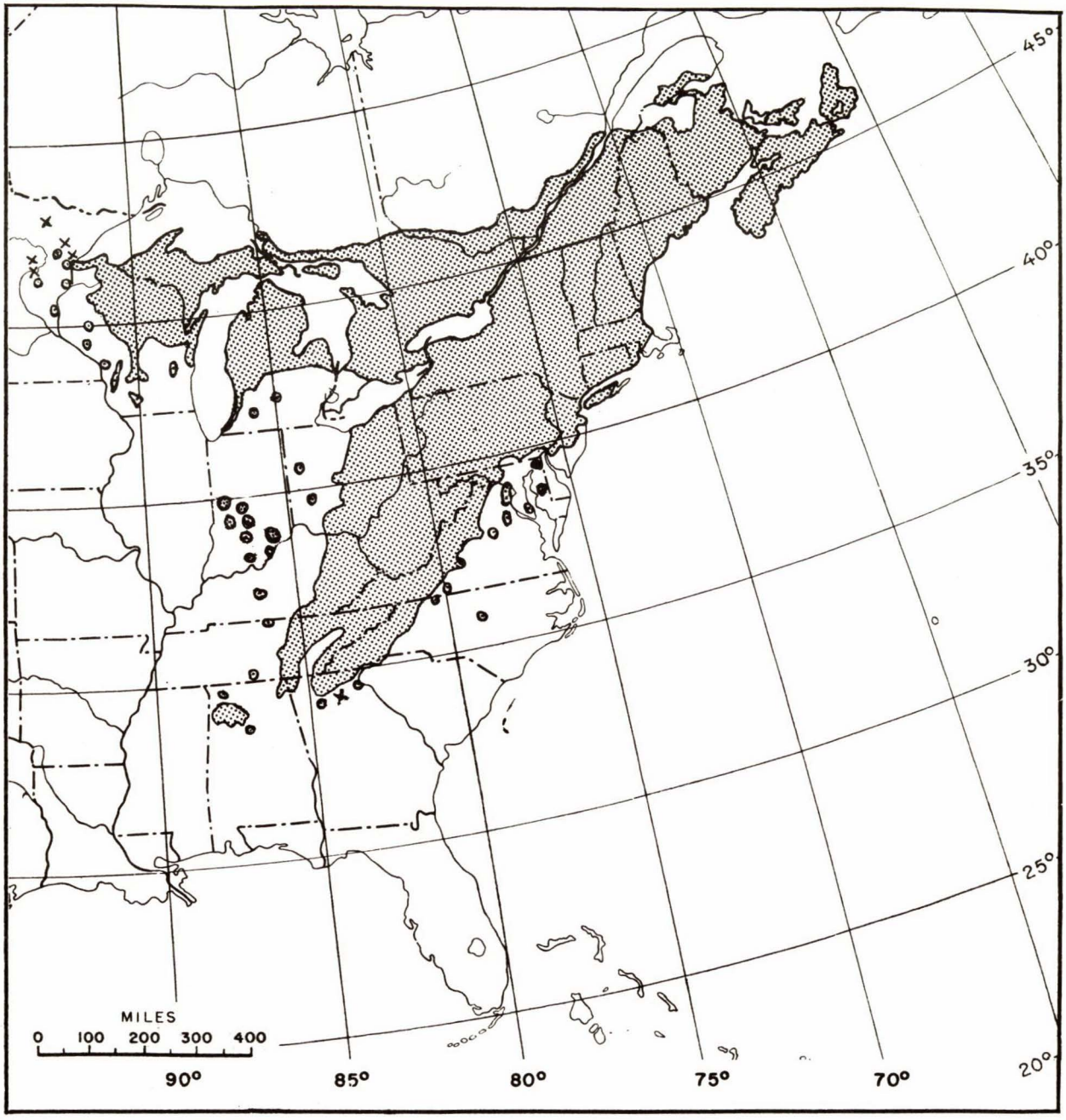

FIGURE 1.—Natural range of eastern hemlock (*Tsuga canadensis* (L.) Carr.).

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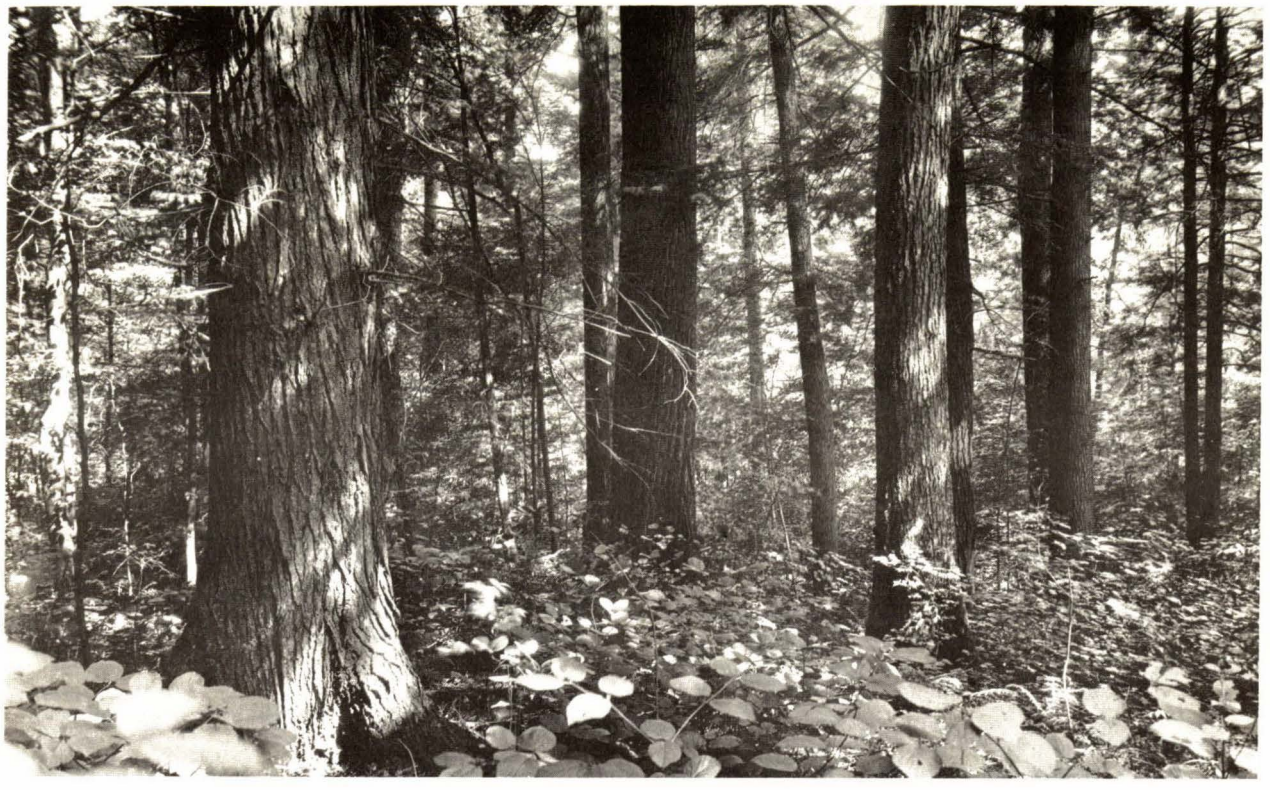

FIGURE 2.—Typical bark of mature, thrifty hemlock. F–237472

EASTERN HEMLOCK

(*Tsuga canadensis* (L.) Carr.)

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DISTRIBUTION

The natural range of eastern hemlock extends from Nova Scotia westward through New Brunswick, Maine, extreme southern Quebec, lower Ontario, central and northern Michigan, Wisconsin, and parts of eastern Minnesota. It extends southwest from New England through the Middle Atlantic States and eastern Ohio and along the Appalachian Mountains to northern Georgia and Alabama (fig. 1). Eastern hemlock also grows in scattered islands in southern Indiana.

Eastern hemlock grows best in a cool humid climate that has an adequate moisture in all seasons. However, at the extremities of its range, it is found in drier localities. Like eastern white pine, eastern hemlock grows best in the southern Appalachian Mountains where 150-year-old trees may reach a diameter at breast height (d.b.h.) of 30 inches and heights of 115 feet.

Soil requirements for this species are not exacting, but moist soil conditions are preferred. Eastern hemlock-hardwood stands are usually found on loamy soils rich in decayed vegetation, although hemlock-white pine stands usually grow best on sandy soils well mixed with humus. Eastern hemlock also will grow well on moist limestone soils, as well as on moist or almost swampy loamy clays.

Within the northern and northeastern part of its natural range, eastern hemlock grows well from near sea level to about 2,400 feet elevation. Throughout the central part of its range (New York, Pennsylvania, and West Virginia), it is found mostly at elevations between

1,000 and 3,000 feet. In the southern Appalachians, it is usually limited to the mountains at elevations between 2,000 and 5,000 feet. In the western and southern extremes of its natural range, eastern hemlock is confined to moist cool valleys, north and east slopes, coves, and sides of ravines.

DESCRIPTION AND GROWTH

Mature eastern hemlock commonly reaches a height of 80 to 100 feet with a d.b.h. of 2 to 3 feet, although individual trees may become much larger. (The record for age is 988 years; for d.b.h., 84 inches; and for total height, 160 feet.) In the early stages of development, the open-grown graceful trees typically have a dense pyramidal crown whose lower branches often sweep the ground. However, young eastern hemlocks that develop in dense shade are usually flat-topped and unsymmetrical. In contrast to the other eastern conifers, the terminal leader is flexible and tends to curve away from the prevailing winds.

Mature hemlocks usually have straight, tapering trunks with dense long crowns covering up to two-thirds of the tree bole. The crowns of old mature trees tend to be ragged.

Eastern hemlock grows in nearly pure stands, as well as in mixtures with many commercial species. It is an important element in four commonly recognized forest types: White pine-hemlock, hemlock, hemlock-yellow birch, and yellow poplar-hemlock. Eastern hemlock is less prominent in many other forest types like balsam fir, red spruce, sugar maple-beech-yellow birch, black cherry–sugar maple, and northern red oak-basswood-white ash. It often grows with white pine in stands originating after fire, windthrow, or other catastrophic disturbances. On favorable sites, eastern hemlock usually forms climatic climax associations capable of self-renewal.

Even though this species bears abundant seed at 2- to 3-year intervals, it reproduces well only on moist ground rich in organic matter. Eastern hemlock is the most tolerant of eastern conifers. Young established trees can endure considerable amounts of shade and frequently form the understory in mixed stands where 50-to-100-year old eastern hemlocks with a d.b.h. of only a few inches are not uncommon.

Because hemlock is tolerant of shade, the lower branches remain alive for many years. When the branches die, they persist for many years leaving hard, flintlike knots. Because of this poor self-pruning ability, even in dense stands, clear trunks more than 30 feet long are uncommon except in very old trees.

The bark of young hemlock is flaky or scaly and becomes crossed by deep longitudinal fissures as the tree matures (fig. 2). On older mature trees, the bark is often 2 to 3 inches thick at the stump and deeply furrowed; it is normally reddish brown.

The needles are short, flat, and narrow (fig. 3). They are about ⅕ inch wide and ⅓ to ⅔ inch long. New needles are light green but soon change to a dark, lustrous green on the upper surface and a whitish green underneath.

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FIGURE 3.—Foliage and cones of eastern hemlock.

The cones are among the smallest of the pine family —½ to ¾ inch long. They are pale green until maturity in the autumn when they become dark brown. The individual seeds are very small, about 185,000 to a pound.

Eastern hemlock is susceptible to several types of injury. Hemlock loopers probably cause the most damage by eating the foliage and can quickly kill a tree. Because of its shallow root system, eastern hemlock is very susceptible to drought injury and windthrow and is very sensitive to fire. A ground fire burning through the humus can kill eastern hemlock, while other species with a deeper root system escape injury. This species usually remains relatively free from decay-causing fungi although mature trees may be attacked by heart rot fungi like red ring rot and brown butt rot.

COMMON NAMES

Eastern hemlock, a member of the pine family, generally is known simply as hemlock. The names hemlock spruce and spruce pine are sometimes used, particularly in the southern Appalachians, and Canadian hemlock is used in the north.

RELATED COMMERCIAL SPECIES

There are about 10 known species of hemlock (*Tsuga*) in the world. Four of these—eastern hemlock (*T. canadensis*), Carolina hemlock (*T. caroliniana*), western hemlock (*T. heterophylla*), and mountain hemlock (*T. mertensiana*)—grow in North America. Carolina hemlock, similar to eastern hemlock, is found only

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FIGURE 4.—Old mature eastern hemlock tree with ragged crown.

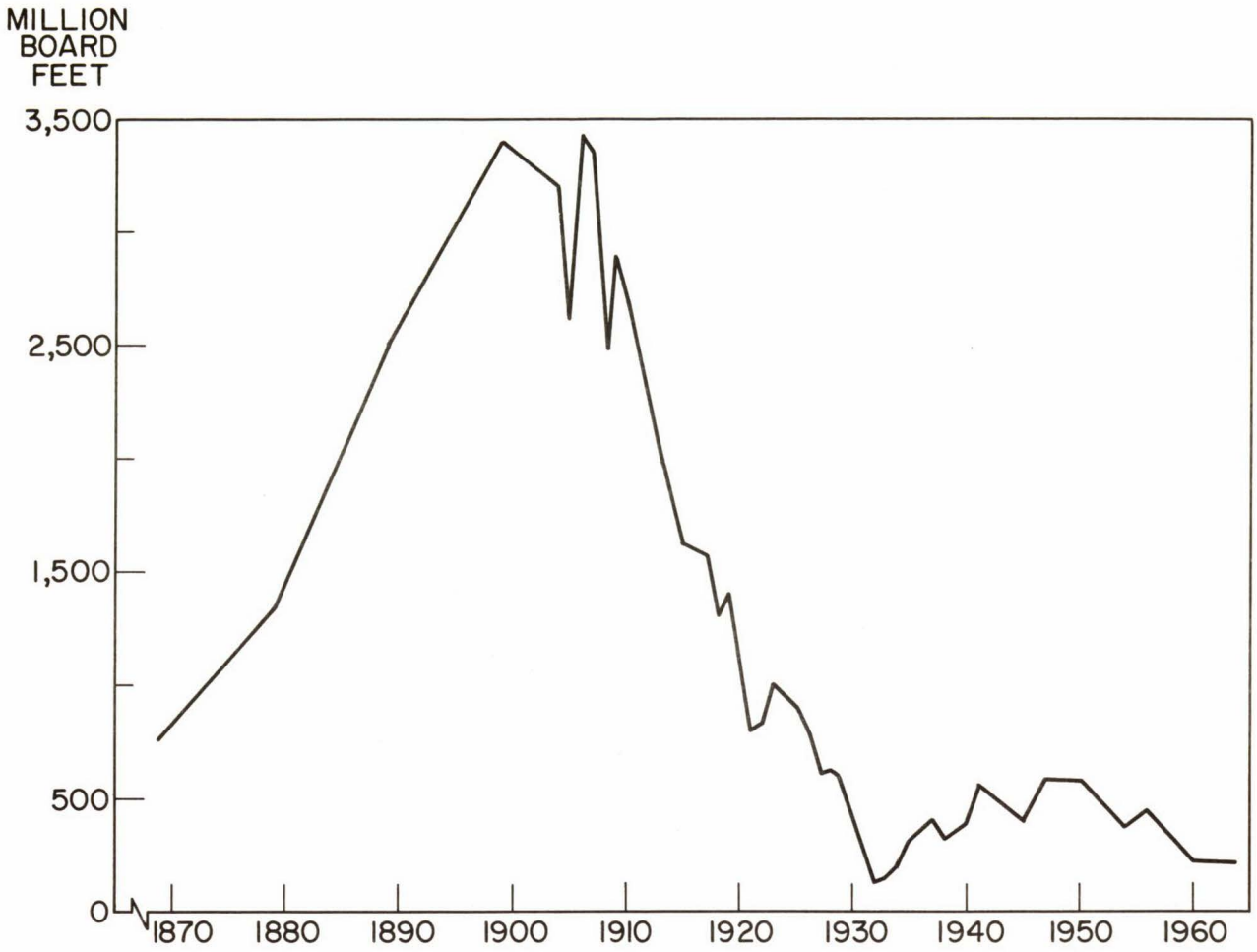

FIGURE 5.—Eastern hemlock lumber production, 1869–1964.

in the Appalachian Mountains of North Carolina, south Carolina, and Georgia. Both mountain and western hemlock are found in the western and northwestern parts of the United States. Western hemlock is the most important commercial species.

The data on tamarack (*Larix laricina*) are sometimes included in production and inventory figures for eastern hemlock, especially in the New England States.

SUPPLY

In 1963 the total stand of eastern hemlock of sawtimber size in the United States was estimated to be 13.5 billion bd. ft. About 61 percent of this volume grew in the Northeastern States, 25 percent in the Lake States, and 14 percent in the southern Appalachians. The States of Maine, Michigan, and New York each contained approximately 15 percent of the total volume.

The reported net volume of growing-stock trees in 1963, which includes all trees larger than 5 inches d.b.h., was about 64 million cords or 4,813 million cubic feet.

PRODUCTION

Eastern hemlock lumber was produced during the early colonial days in the Eastern United States. The earliest available statistics, for 1869, show 770 million bd. ft. produced that year. Annual lumber production increased rapidly until 1906 when 3,431 million bd. ft. was produced (fig. 5).

After 1906 production declined sharply, reaching a low in 1932 of 138 million bd. ft. By 1950, hemlock lumber production had risen to 575 million bd. ft.; about one-third of this was produced in Michigan. In 1964, according to the Bureau of the Census, eastern hemlock lumber production was about 218 million bd. ft.

The earliest available statistics for paper pulp manufacture in 1905, showed that 375,000 cords of eastern hemlock was consumed. Hemlock pulpwood production reached a maximum of 818,000 cords in 1927, or about 12 percent of the total. By 1964, eastern hemlock pulpwood production—mostly in Maine, Michigan, and Wisconsin—had declined to about 370,000 cords.

CHARACTERISTICS AND PROPERTIES

Eastern hemlock wood is light brown to buff. The summerwood portion of each annual ring is normally slightly darker than the springwood portion. The sapwood is usually not distinct from the heartwood, but occasionally the last few annual rings near the bark are lighter in color than the inner annual rings. Freshly cut hemlock has a sour odor but, when seasoned, the wood is odorless. The wood is coarse, uneven in texture, and splinters easily when worked with tools. It is moderately light (about 28 pounds per cubic foot at 12-percent moisture content), moderately weak in bending strength, moderately strong in end compression, low in splitting resistance, and average in nail-holding capacity. Eastern hemlock wood glues easily and holds paint moderately well but not as well as cedars and white pines. It is not durable when exposed to conditions favorable to decay.

The wood tends to separate parallel to the annual rings. When this condition, called ring shake, is extensive, the lumber may be worthless for most uses. The causes of ring shake are not definitely known, but observation and research have sometimes related it to tree age and to uneven growth. Recent research indicates that sapsucker damage to the cambium also may be associated with ring shake.

Paper pulp made from eastern hemlock is darker and usually weaker than pulp made from spruces; it is also difficult to bleach. For these reasons eastern hemlock paper pulp is undesirable for high-grade papers. Both the sulfate and sulfite processes may be used for pulping hemlock, but the sulfite is used more often. Hemlock pulp also can be produced by the mechanical or groundwood process.

PRINCIPAL USES

Eastern hemlock is used primarily for lumber and paper pulp. About three-fourths of the hemlock lumber produced is used for light framing, sheathing, roofing, and subflooring. The remainder of the lumber is used for boxes, crates, and pallets; railroad car construction and repair; general millwork, and sign construction. A small amount is used for specialty items like toys and sporting goods. Hemlock paper is used primarily for newsprint and wrapping papers.

Hemlock bark contains 10- to 13-percent tannin and has long been an important source of this product. In 1900 tannin was extracted from over a million cords of hemlock bark. However, because newer tanning processes utilizing synthetic or imported products are more economical, the commercial use of hemlock bark for tannin extraction has practically disappeared.

Hemlock ranks high among the conifers as an ornamental tree and develops into a beautiful ornamental when grown under proper conditions. It also reacts well to shearing and makes a good hedge.

REFERENCES

Betts, H. S.
1953. Eastern hemlock. U.S. Dep. Agr. Forest Serv. Amer. Woods. 6 p.

Bureau of the Census.
1950–66. Current industrial reports—lumber production and mill stocks. U.S. Dep. Com. Annu. reps. 1950–66.

Clepper, Henry E.
1934. Hemlock—the State tree of Pennsylvania. Penn. Dep. Forests and Waters. Bull. 52., 27 p., illus.

Frothingham, E. H.
1915. The eastern hemlock. U.S. Dep. Agr. Bull. 152, 41 p., illus.

Gill, Thomas G.
1965. Wood used in manufacturing industries. U.S. Dep. Agr. Statist. Bull. 343, 121 p., illus.

Harlow, W. M., and Harrar, E. S.
1958. Textbook of dendrology. 4th ed. 561 p., illus.

Horn, Arthur G.
1965. Pulpwood production in Lake States counties, 1964. U.S. Dep. Agr. Forest Serv. Lake States Exp. Sta. Res. Bull. LS–2, 19 p., illus.

Kingsley, Neal P.
1967. Pulpwood production in the Northeast, 1964. U.S. Dep. Agr. Forest Serv. Res. Bull. NE–5, 27 p., illus.

Panshin, A. J. de Zeeuw, Carl, and Brown, H. P.
1964. Textbook of wood technology. Vol. I—Structure, identification, uses, and properties of the commercial woods of the United States. Ed. 2. 643 p., illus.

USDA Forest Service.
1958. Timber resources for America's future. U.S. Dep. Agr. Forest Serv. Forest Res. Rep. 14, 713 p., illus.

USDA Forest Service.
1965a. Silvics of forest trees of the United States. U.S. Dep. Agr., Agr. Handb. 271, 762 p., illus.

USDA Forest Service.
1965b. Timber trends in the United States. U.S. Dep. Agr. Forest Serv. Forest Res. Rep. 17, 35 p., illus.

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